

TEST REPORT

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PRODUCT EVALUATED: Silent Running SR 1000 #13090501
EVALUATION PROPERTY: ASTM E1354 – 11b Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter

Report of Testing Silent Running SR 1000 #13090501 for compliance with the applicable requirements of the following criteria: ASTM E1354 – 11b Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter

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2 Introduction

Intertek has conducted testing for Current Inc, on Silent Running SR 1000 #13090501, to evaluate heat and smoke release rates. Testing was conducted following the standard methods of ASTM E 1354 – 11b Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter. This evaluation began Sept 26, 2013 and was completed Sept 27, 2013.

3 Test Samples

3.1. SAMPLE SELECTION

Samples were submitted to Intertek directly from the client. Samples were not independently selected for testing. Samples were received at the Evaluation Center Sept 25, 2013 in good condition.

3.2. SAMPLE AND ASSEMBLY DESCRIPTION

Silent Running SR 1000 #13090501

Steel Plate Coated with Silent Running SR 1000 Marine Coating

4 Testing and Evaluation Methods

4.1. ASTM E1354 – 11b Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter

This test method is based on the observation that, generally, the net heat of combustion is directly related to the amount of oxygen required for combustion. The relationship is that approximately 13100 kJ of heat are released per 1 kg of oxygen consumed. Specimens in the test are burned in ambient air conditions, while being subjected to a predetermined external heat flux, which can be set from 0 to 100 kW/m². Burning may be either with or without a spark ignition. The primary measurements are oxygen concentrations and exhaust gas flow rate. Additional measurements include the mass-loss rate of the specimen, the time to sustained flaming and smoke obscuration, or as required in the relevant material or performance standard.

The cold trap was checked and closed. The sorbents were replaced. The power was turned on to the cone heater and the exhaust blower. (Power to the oxygen analyzer, load cell, and pressure transducer is not to be turned off on a daily basis.) The exhaust flow was set to a rate of 0.024 +/- 0.002 m³/s. (Under room temperature conditions this corresponds to approximately 30 g/s.) The required calibration procedures specified in Section 9 of ASTM E1354 were

performed. The external ignition was positioned in the location appropriate to the orientation being used. The radiation shield was positioned along with the specimen, in the appropriate holder. The holder must be at room temperature initially. The radiation shield was in place for a sufficient time to ensure stability of operation (load cell equilibrium). The radiation shield was removed and the data collection was initiated. The data collection intervals shall be 5 s or less. The external igniter was pushed into place and powered. The times when flashing or transitory flaming occurs were recorded; if sustained flaming occurred, the time was recorded, and the spark igniter was removed. If the flame extinguished in less than 60 s after turning off the spark, the spark igniter was reinserted within 5 s and turned on.

Collect data until 2 min after any one of the following conditions first occurs:

1. flaming or other signs of combustion cease
2. the average mass loss over a 1-min period has dropped below 150 g/m²
3. the specimen mass has been consumed and the load cell has returned to the pre-test value (in g)
4. the oxygen concentration has returned to near the pretest value for 10 min (as evidenced by a heat release rate of below 5 kW/m²)
5. 60 min have elapsed.

If the specimen does not ignite in 30 min, remove and discard, unless the specimen is showing signs of heat evolution.

4.1.1. Deviation from Standard Method

There were no deviations from the test standard.

4.2. Apparatus

FTT Cone Calorimeter #1174
Mettler Toledo Analytical Scale #1045

5 Testing and Evaluation Results

5.1. RESULTS AND OBSERVATIONS

Sample 1

Specimen information		Specimen number	1	Conditioned?	No
E	13.1 MJ/kg	Nominal duct flow rate	24 l/s	Temperature	N/A
Thickness	7 mm	Edge frame used?	Yes	RH	N/A
Initial mass	331.9 g	Grid used?	No		
Surface area	88.4 cm ²	Manufacturer			
Heat flux	35 kW/m ²	Sponsor	Current Inc		
Separation	25 mm				
Orientation	Horizontal				

Test	Pre-test conditions	Test times	
Standard used	ASTM E1354	Time to ignition	72 s
Date of test	26/09/2013	Time to flameout	313 s
Time of test	22:16	End of test criterion	User entered
Date of report	26/09/2013	End of test time	433 s
		(for calculations)	

Apparatus specifications	Initial conditions	Heat Release Results	
C-factor	0.03817	Baseline ambient oxygen	20.656%
Duct diameter	0.114 m	Baseline oxygen	20.949%
O ₂ delay time	14 s	Baseline carbon dioxide	0.0513%
CO ₂ delay time	12 s	Mass at sustained flaming	331.4 g
CO delay time	12 s		
OD corr. factor	1.0055	THR (0-300)	12.59 MJ/m ²
		THR (0-600)	-
		THR (0-1200)	-
		Fuel load	0.37 MJ/kg

Test results (between 72 and 433 s)		Mean	Peak	at time (s)	
Total heat release	13.7 MJ/m ²	Heat release rate (kW/m ²)	37.88	120.30	95
Total oxygen consumed	9.0 g	Effective heat of comb. (MJ/kg)	19.02	46.67	175
Mass lost	6.4 g	Mass loss rate (g/s)	0.018	0.086	85
Average specific MLR	2.24 g/(s·m ²)	Specific extinction area (m ² /kg)	16.01	69.31	110
Total smoke release	11.9 m ² /m ²	Carbon monoxide yield (kg/kg)	0.0551	0.4810	370
Total smoke production	0.1 m ²	Carbon dioxide yield (kg/kg)	1.45	3.74	175
MAHRE	53.4 kW/m ²				

Test averages	1 min	2 min	3 min	4 min	5 min	6 min	0 s - 460 s	72 s - 460 s
from ignition to ignition plus...								
Heat release rate (kW/m ²)	102.92	83.20	64.69	52.01	43.49	37.88	30.83	36.01
Effective heat of comb. (MJ/kg)	21.75	21.48	21.36	19.96	19.77	19.02	17.65	18.83
Mass loss rate (g/s)	0.045	0.035	0.027	0.023	0.020	0.018	0.016	0.017
Specific extinction area (m ² /kg)	30.89	22.97	19.53	16.83	16.52	16.01	15.60	15.96
Carbon monoxide yield (kg/kg)	0.0177	0.0206	0.0291	0.0387	0.0483	0.0551	0.0533	0.0581
Carbon dioxide yield (kg/kg)	1.61	1.65	1.65	1.54	1.52	1.45	1.34	1.44

Smoke results	
Total smoke release: non-flaming phase (0 s - 72 s)	0.8 m ² /m ²
Total smoke release: flaming phase (72 s - 433 s)	11.9 m ² /m ²
Total smoke release: whole test (0 s - 433 s)	12.8 m ² /m ²

Sample 2

Specimen information

E	13.1 MJ/kg	Specimen number	2	Conditioned?	Yes
Thickness	7 mm	Nominal duct flow rate	24 l/s	Temperature	23°C
Initial mass	337.7 g	Edge frame used?	Yes	RH	50%
Surface area	88.4 cm ²	Grid used?	No		
Heat flux	35 kW/m ²	Manufacturer			
Separation	25 mm	Sponsor	Current Inc		
Orientation	Horizontal				

Test		Pre-test conditions		Test times	
Standard used	ASTM E1354	Ambient temperature	26.2°C	Time to ignition	73 s
Date of test	26/09/2013	Ambient pressure	99.525 kPa	Time to flameout	424 s
Time of test	22:34	Relative humidity	40%	End of test criterion	User entered
Date of report	26/09/2013			End of test time	544 s
				(for calculations)	
Apparatus specifications		Initial conditions		Heat Release Results	
C-factor	0.03817	Baseline ambient oxygen	20.670%	THR (0-300)	15.03 MJ/m ²
Duct diameter	0.114 m	Baseline oxygen	20.958%	THR (0-600)	17.92 MJ/m ²
O2 delay time	14 s	Baseline carbon dioxide	0.0509%	THR (0-1200)	-
CO2 delay time	12 s	Mass at sustained flaming	337.5 g	Fuel load	0.46 MJ/kg
CO delay time	12 s				
OD corr. factor	1.0055				

Test results (between 73 and 544 s)

		Mean	Peak	at time (s)
Total heat release	17.4 MJ/m ²	Heat release rate (kW/m ²)	37.07	110.88
Total oxygen consumed	11.4 g	Effective heat of comb. (MJ/kg)	19.24	56.68
Mass lost	8.0 g	Mass loss rate (g/s)	0.017	0.051
Average specific MLR	2.30 g/(s·m ²)	Specific extinction area (m ² /kg)	12.34	61.76
Total smoke release	12.2 m ² /m ²	Carbon monoxide yield (kg/kg)	0.0512	2.5119
Total smoke production	0.1 m ²	Carbon dioxide yield (kg/kg)	1.45	21.26
MAHRE	57.6 kW/m ²			

Test averages

from ignition to ignition plus...	1 min	2 min	3 min	4 min	5 min	6 min	0 s - 745 s	73 s - 745 s
Heat release rate (kW/m ²)	97.51	92.61	77.51	63.32	53.06	45.89	25.73	28.55
Effective heat of comb. (MJ/kg)	20.64	21.35	21.22	20.96	20.64	20.28	17.05	17.52
Mass loss rate (g/s)	0.042	0.039	0.032	0.027	0.023	0.020	0.014	0.015
Specific extinction area (m ² /kg)	19.83	20.93	17.13	15.37	14.26	13.56	11.27	10.78
Carbon monoxide yield (kg/kg)	0.0159	0.0186	0.0217	0.0282	0.0352	0.0413	0.0639	0.0659
Carbon dioxide yield (kg/kg)	1.49	1.61	1.62	1.60	1.58	1.54	1.28	1.32

Smoke results

Total smoke release: non-flaming phase (0 s - 73 s)	0.7 m ² /m ²
Total smoke release: flaming phase (73 s - 544 s)	12.2 m ² /m ²
Total smoke release: whole test (0 s - 544 s)	13.0 m ² /m ²

Sample 3

Specimen information

E	13.1 MJ/kg	Specimen number	3	Conditioned?	Yes
Thickness	7 mm	Nominal duct flow rate	24 l/s	Temperature	23°C
Initial mass	328.4 g	Edge frame used?	Yes	RH	50%
Surface area	88.4 cm ²	Grid used?	No		
Heat flux	35 kW/m ²	Manufacturer			
Separation	25 mm	Sponsor	Current Inc		
Orientation	Horizontal				

Test		Pre-test conditions		Test times	
Standard used	ASTM E1354	Ambient temperature	25.9°C	Time to ignition	78 s
Date of test	26/09/2013	Ambient pressure	99.505 kPa	Time to flameout	297 s
Time of test	22:53	Relative humidity	40%	End of test criterion	User entered
Date of report	26/09/2013			End of test time	417 s
				(for calculations)	

Apparatus specifications		Initial conditions		Heat Release Results	
C-factor	0.03817	Baseline ambient oxygen	20.667%	THR (0-300)	13.00 MJ/m ²
Duct diameter	0.114 m	Baseline oxygen	20.950%	THR (0-600)	15.77 MJ/m ²
O2 delay time	14 s	Baseline carbon dioxide	0.0512%	THR (0-1200)	-
CO2 delay time	12 s	Mass at sustained flaming	328.0 g	Fuel load	0.37 MJ/kg
CO delay time	12 s				
OD corr. factor	1.0055				

Test results (between 78 and 417 s)

		Mean	Peak	at time (s)
Total heat release	13.8 MJ/m ²	Heat release rate (kW/m ²)	40.41	114.14
Total oxygen consumed	9.0 g	Effective heat of comb. (MJ/kg)	18.82	60.87
Mass lost	6.1 g	Mass loss rate (g/s)	0.019	0.068
Average specific MLR	2.53 g/(s·m ²)	Specific extinction area (m ² /kg)	7.76	87.74
Total smoke release	7.1 m ² /m ²	Carbon monoxide yield (kg/kg)	0.0466	1.2242
Total smoke production	0.1 m ²	Carbon dioxide yield (kg/kg)	1.42	9.76
MAHRE	52.6 kW/m ²			180

Test averages

from ignition to ignition plus...	1 min	2 min	3 min	4 min	5 min	6 min	0 s - 635 s	78 s - 635 s
Heat release rate (kW/m ²)	99.50	85.14	67.30	53.81	44.74	-	25.48	28.68
Effective heat of comb. (MJ/kg)	21.30	21.47	21.39	20.75	19.46	-	16.85	17.44
Mass loss rate (g/s)	0.041	0.035	0.028	0.023	0.020	-	0.014	0.015
Specific extinction area (m ² /kg)	14.35	14.33	11.37	9.60	8.28	-	7.89	7.81
Carbon monoxide yield (kg/kg)	0.0172	0.0204	0.0270	0.0364	0.0429	-	0.0647	0.0676
Carbon dioxide yield (kg/kg)	1.56	1.62	1.63	1.58	1.47	-	1.23	1.28

Smoke results

Total smoke release: non-flaming phase (0 s - 78 s)	0.5 m ² /m ²
Total smoke release: flaming phase (78 s - 417 s)	7.1 m ² /m ²
Total smoke release: whole test (0 s - 417 s)	7.7 m ² /m ²




5.2. EXAMINATION OF RESULTS

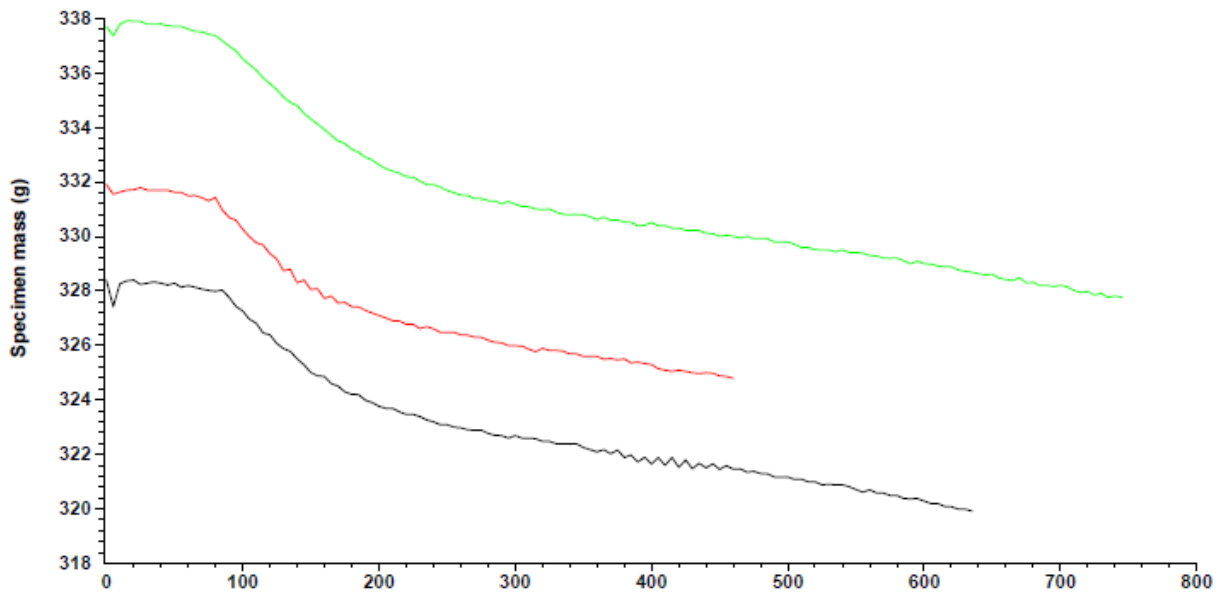
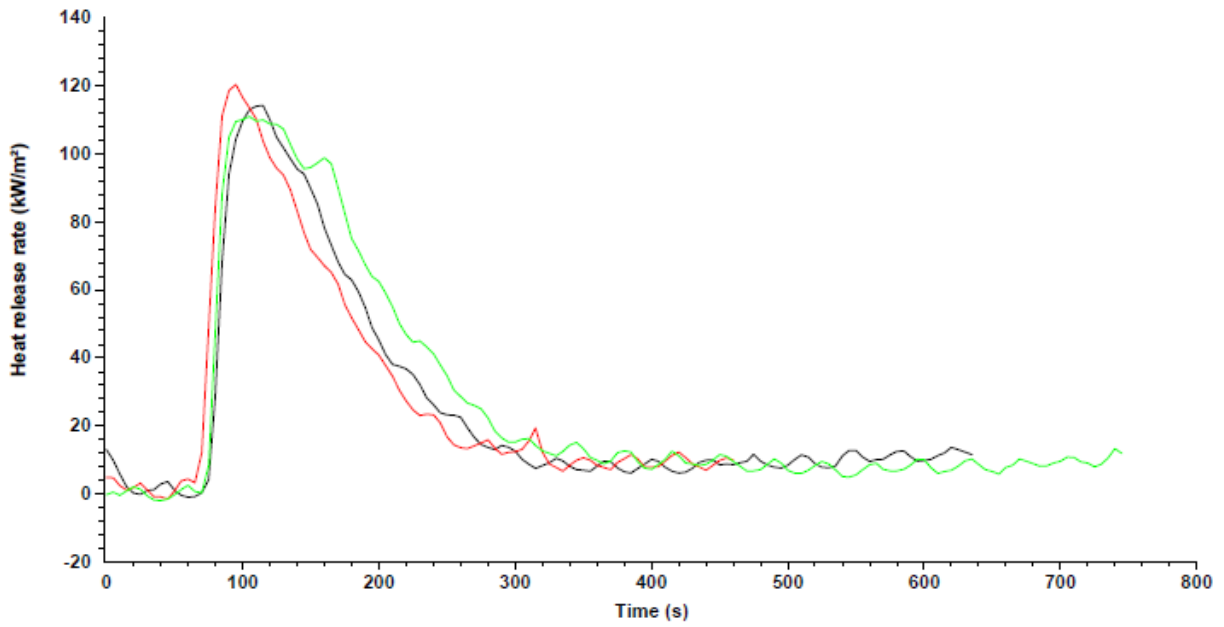
Combined Results

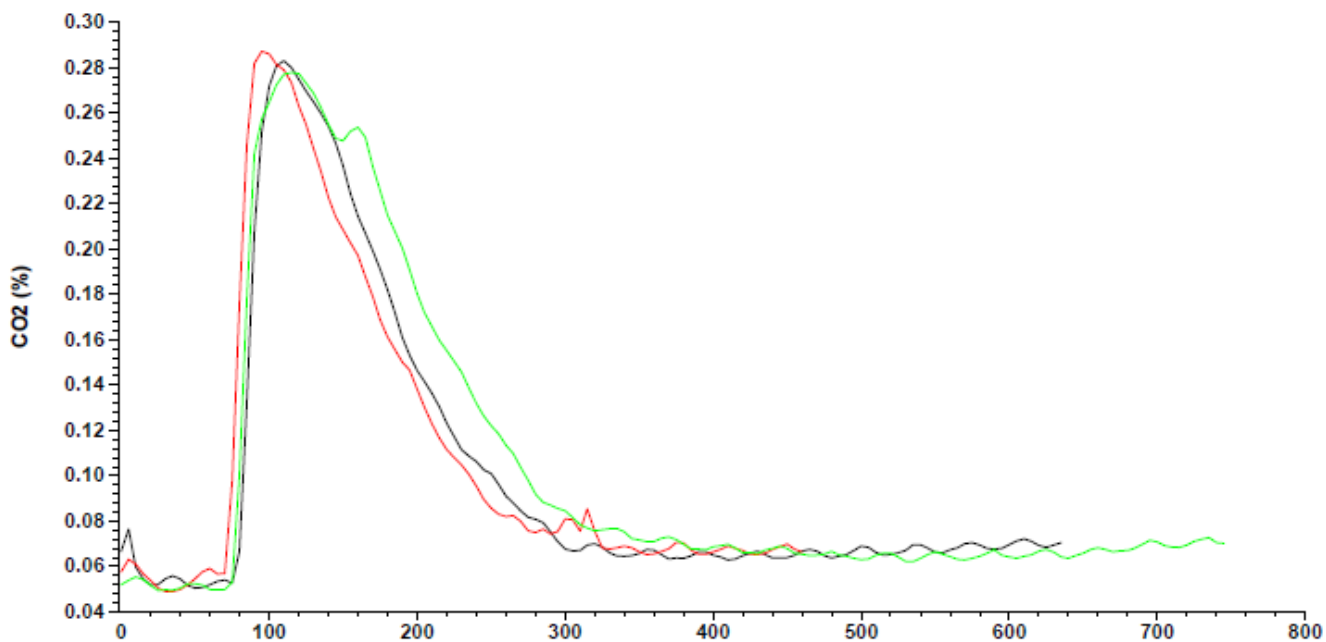
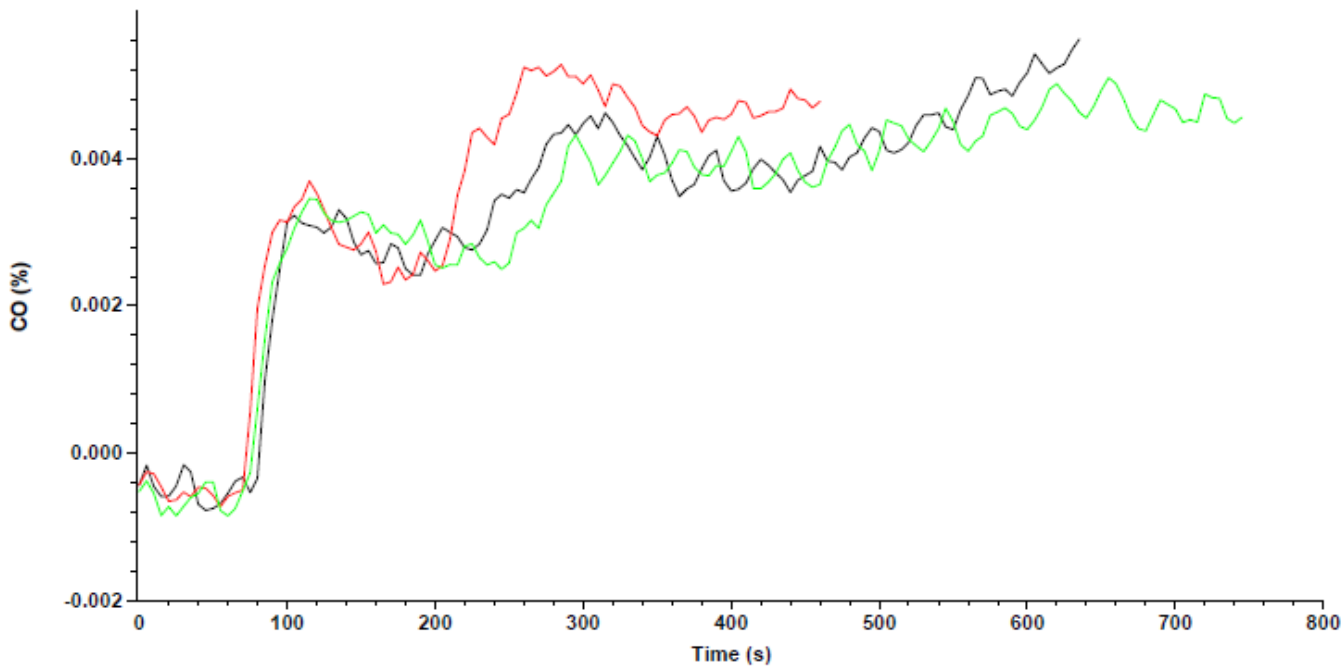
Test averages									
Test	t(iq) (s)	t(fo) (s)	t(end) (s)	HRR(peak) (kW/m ²)	tpeak (s)	THR (MJ/m ²)	HRR(60) (kW/m ²)	HRR(180) (kW/m ²)	HRR(300) (kW/m ²)
Mean	74.3	344.7	464.7	115.11	105	14.99	99.98	69.83	47.10
1	78	297	417	114.14	115	13.79	99.50	67.30	44.74
2	72	313	433	120.30	95	13.75	102.92	64.69	43.49
3	73	424	544	110.88	105	17.42	97.51	77.51	53.06

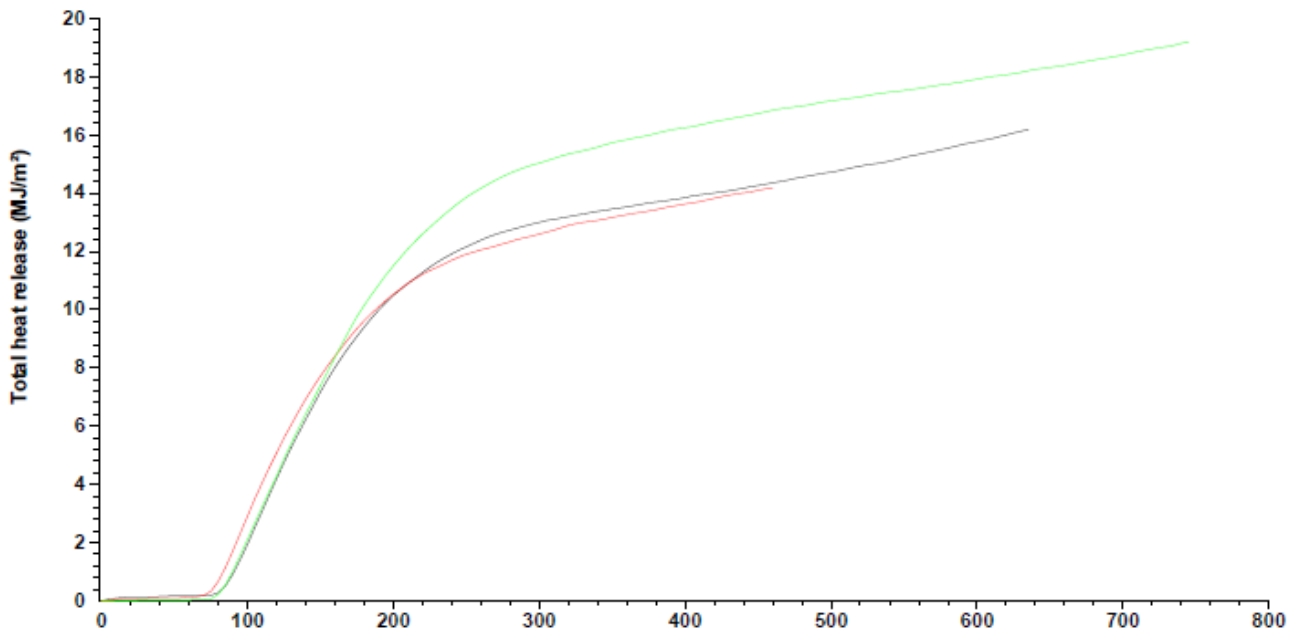
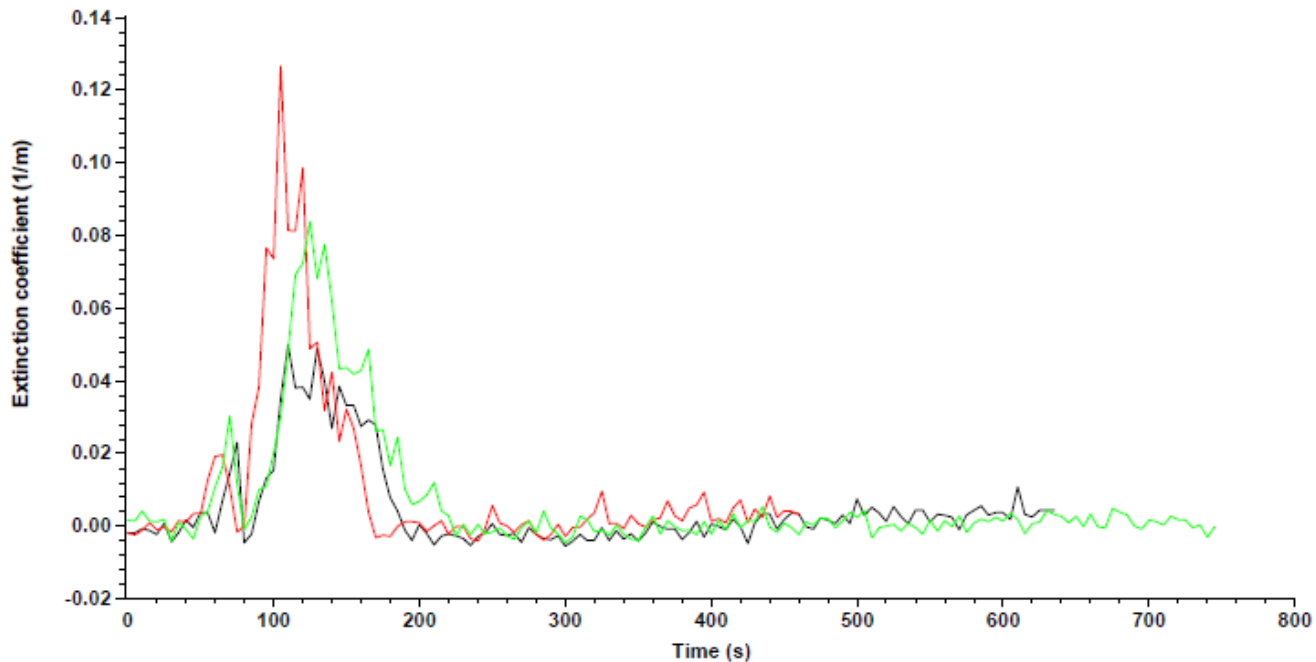
Test	Flux (kW/m ²)	t (mm)	Area (cm ²)	m(i) (g)	m(s) (g)	m(f) (g)	Δm (g)	Ave MLR (g/s·m ²)	EHC(av) (MJ/kg)
Mean		7		332.7	332.3	325.5	6.9	2.4	19.03
1	35	7	88.4	328.4	328.0	321.9	6.1	2.5	18.82
2	35	7	88.4	331.9	331.4	325.0	6.4	2.2	19.02
3	35	7	88.4	337.7	337.5	329.5	8.0	2.3	19.24

Test	THR(0-300) (MJ/m ²)	THR(0-600) (MJ/m ²)	THR(0-1200) (MJ/m ²)	SPR(av) (m ² /s)	SEA(av) (m ² /kg)	Fuel load (MJ/kg)	MARHE (kW/m ²)
Mean	13.54	-	-	0.0002	12.04	0.40	54.53
1	13.00	15.77	-	0.0001	7.76	0.37	52.59
2	12.59	-	-	0.0003	16.01	0.37	53.42
3	15.03	17.92	-	0.0002	12.34	0.46	57.58

Test	Date	Specimen #	Line colour	Filename
1	26/09/2013	3		C:\CC5\Data\Current Inc\101351744 Current Inc Silent Running SAR 1000 3.CSV
2	26/09/2013	1		C:\CC5\DATA\13090002.CSV
3	26/09/2013	2		C:\CC5\Data\Current Inc\101351744 Current Inc Silent Running SAR 1000 2.CSV







6 Conclusion

Intertek has conducted testing for Current Inc, on Silent Running SR 1000 #13090501, to evaluate heat and smoke release rates. Testing was conducted following the standard methods of ASTM E 1354 – 11b Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter.

The conclusions of this test report may not be used as part of the requirements for Intertek product certification. Authority to Mark must be issued for a product to become certified.

INTERTEK



Reported by:

Mark Crawford
Chemist Team Lead



Reviewed by:

Bryan Bowman
Chemist

REVISION SUMMARY

DATE	SUMMARY
Sept, 27, 2013	Original date of report